Ray Thelwell 4 Jan 60

1. Introduction to Operations Research
   Churchman Ackoff Arnoff
   * Wiley

2. Scientific Method
   a. Aim
   b. Collect Data
   c. Analyze
   d. Conclusions
   e. Test
   f. Installations
   g. Follow Up

Scientist + Brings More powerful analysis & other abilities

Apply: Skills & Background information
Probability
Statistics
Mathematics
Physics
!

⇓

Orient toward Overall organization objectives

3. Thomas Suggests: —
   Wharton, Ordnance, Hunsaker, University of Pennsylvania paper on Systems Engineering

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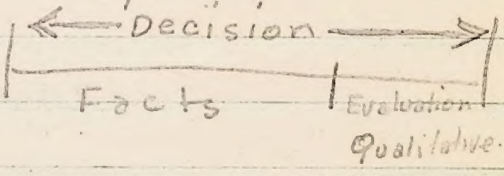
4. Question of organization location of OR, Management Engineering;

5. Scientific Method.

a. Aim → Study Entire System → Numerical Objective



Afternoon 4 Jan 60

b. Collect Data → Data often not found in accounting system → Relevent data

c. Analyze → Model → mathematical → statistical

"Simplification"

d. Conclusions →

e. Test → Failure to test organization

f. Installation →

g. Follow Up

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6. Topics for this week.

a. Probability
Queuing theory (waiting line theory)

b. Statistics
Inference & decisions

c. Mathematical Model
Steps in study
} specifically Inventory

d. Mathematical Programming
Problem Formulation

e. Simulation

f. Outside Speaker – Identifying Problems
Org.

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7. Probability.

$$P = \lim_{N \to \infty} \frac{n}{N}$$

a. Addition (either, or)

$P(A+B) = P(A) + P(B)$ if the events are mutually exclusive. (If the events can not happen together.)

When things do happen together:

$P(A+B) = P(A) + P(B) - P(AB)$

b. Multiplication (independent sub-events)

$P(A \cdot B) = P(A) \cdot P(B)$

c. Conditional (not independent) if

$P(AB) = P(A)\, P(B/A)$ ← Conditional probability

8 Red beads
2 Black beads

P 1st Black
Then Red
Did not return
bead after draw

8R
2B

$\left(\frac{2}{10}\right)\left(\frac{8}{9}\right)$

$\left(\frac{18}{90}\right)\left(\frac{80}{90}\right)$

$P\left(\begin{matrix}\text{black or red} \\ \text{order makes no} \\ \text{difference}\end{matrix}\right) = P(B)P(R) + P(R)P(B)$

$= \left(\frac{2}{10}\right)\left(\frac{8}{9}\right) + \left(\frac{8}{10}\right)\left(\frac{2}{9}\right)$

1. 10 red, 20 white, and 30 blue. Total 60

a. $\frac{1}{2}$

b. $\frac{2}{3}$

c. $\frac{1}{3}$

2. Draws out 2, returning 1 after 1st draw.

$P(R)\,P(B)\,P(W) = P(\frac{1}{6})\,P(\frac{1}{3})\,P(\frac{1}{2})$

a. Two blues $\frac{15}{60}$

b. First white then red $\frac{20}{60} \cdot \frac{10}{60} = \frac{30}{360} = \frac{1}{18}$

c. Red and white $\frac{10}{60} + \frac{20}{60} = \frac{30}{60} = \frac{1}{2}$

$(\frac{20}{60})(\frac{10}{60}) + (\frac{10}{60})(\frac{20}{60}) = \frac{6}{100}$

3. Part A Lot 6% Defective $= \frac{6}{100}$

Part B Lot 4% Defective $= \frac{4}{100}$

$\frac{6}{100} + \frac{4}{100} = \frac{10}{100}$ or $\frac{1}{10}$ defective

Part A $\frac{94}{100}$

Part B $\frac{96}{100}$

$P(A+B) = P(A) + P(B)$.

$\frac{94}{100} + \frac{96}{100} = \frac{180}{200} = \frac{9}{10}$ not defective

5. a. Each $\frac{1}{4}$ in hitting. $= P(\frac{1}{4}) + P(\frac{1}{16}) + P(\frac{1}{64}) + P(\frac{1}{256})$

$\frac{64}{256} + \frac{16}{256} + \frac{4}{256} + \frac{1}{256} = \frac{85}{256}$

$\frac{96}{100} \cdot \frac{94}{100} = \frac{384}{400} = \frac{192}{200}$

8.

Problem 1 (10R, 20W, 30B)

a. $\frac{30}{60}$

b. $\frac{40}{60}$

c. $\frac{20}{60}$

Problem 2.

a. Two blue $\left(\frac{30}{60}\right)\left(\frac{30}{60}\right)$

b. First W then R $\left(\frac{20}{60}\right)\cdot\left(\frac{10}{60}\right)$

c. Red & White $\left(\frac{20}{60}\right)\left(\frac{10}{60}\right) + \left(\frac{10}{60}\right)\left(\frac{20}{60}\right)$

Problem 3

$$P(def) = P(A_D) + P(B_D) - P(A_D B_D)$$

6 cont 5 Jan 60 p

$M = 4,500$ units/mo inc factor of 9.

Determine the order quantity & time between orders for the least total cost for one year.

$$t_{so} = \sqrt{\frac{2(100)}{(4500)(\frac{1}{12})}} = \sqrt{\frac{2(100)}{(9)(500)(\frac{1}{12})}} =$$

$$\sqrt{\frac{1}{9}}\sqrt{\frac{2(100)}{(500)(\frac{1}{12})}} = \frac{1}{3}\sqrt{\frac{2(100)}{(500)(\frac{1}{12})}} = .7 \text{ mo}$$

$$q_o = M t_{so} \approx 3300$$

$$TEC_{4500_o} = \frac{24(100)}{.7} \approx \$3425$$

$$500\,TEC_o = \$1142$$

$M = 125$ units/month

$125\,TEC =$